

- 1 -

Self-closing diaphragm valve

The invention relates to a self-closing diaphragm valve with a slit diaphragm and a dome-like securing part 5 associated with a mounting region of the diaphragm.

A self-closing diaphragm valve of this type is known from US patent specification 1,989,714 and comprises a rubber plate. According to one embodiment, the latter 10 is clamped against the end surface of the neck of a dispensing container by a cup-like cap part. An indent of the cup base of the securing part, this base having a window in the center, indents the diaphragm in a gently curved manner counter to the dispensing 15 direction of the medium. Located in the vicinity of the periphery of the cup-like securing part is a latching bead, which projects on the neck side and engages in a matching groove of the neck. The other versions interact with a specific clamping ring which supports 20 the diaphragm on the periphery. The securing part, in contrast, is formed directly by the neck, which has a corresponding inwardly projecting section.

It is an object of the invention to develop the 25 mounting region for pre-assembly of the self-closing diaphragm valve.

This object is achieved first and foremost in the case of a self-closing diaphragm valve having the features 30 of Claim 1, this being based on the fact that the securing part is connected in a positively locking or integral manner to the diaphragm and is formed in order to be secured in a closure part by latching or over-engagement on the outer periphery of the circumference.

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Such a configuration achieves a diaphragm valve which can be pre-assembled ready for use. The relatively flexible diaphragm is seated on the intrinsically more stable securing part. The latter acts like a frame, the

periphery of which has clippable elasticity, for achieving the abovementioned securing action by over-engagement or latching on a container-like object. Via the dome-like mounting region of the securing part, the
5 curvature is distributed further over the entire diaphragm. This may be strictly in the form of a spherical cap. In this case, it is possible to achieve a rotationally symmetrical arcuate profile in the same direction, although it is also possible to have a
10 differing, e.g. more gentle, curved profile, for example in the central region of the diaphragm. Integral bonding involves the crosslinking of the materials. It is likewise possible to use adhesive bonding and ultrasound. The integral bonding preferably
15 does not comprise encapsulation of the diaphragm by injection molding.

The subject matters of the rest of the claims are explained hereinbelow with reference to the subject
20 matter of Claim 1, but may also be important in respect of their independent wording. It is thus further provided that the diaphragm rests at least centrally on a plate part. The plate part, which functions as a deflecting wall, supports the central slit region of
25 the diaphragm. Outside the center, the plate part rises up and/or projects in a gap-forming manner. The technical design in this respect even aids the discharge of pellet-like bodies, in particular guidance toward the pushing-out slit region of the diaphragm. It
30 is further advantageous here if the plate part is formed to taper in the direction of the diaphragm, possibly in a trumpet-like configuration. It is likewise advantageous if the plate part tapers in a step-like manner. A stepped cone is conceivable here.
35 This even has a loosening action in respect of the material which is to be dispensed. It is advantageous, furthermore, if the diaphragm rests with prestressing on the plate part or vice versa. This requires a deliberate discharging force, for example with the

dispensing container used being handled like the conventional squeeze bottle. The invention also relates to the fact that the securing part is formed as an annular flat part. The corresponding flat form provides
5 a relatively wide fastening zone or mounting region, in particular in respect of the integral bonding. Furthermore, it proves to be advantageous if the cross-section of the securing part converges in the direction of its center. This results in a certain resilience in
10 respect of producing the securing action by over-engagement or latching. Furthermore, it is proposed that the securing part has an outer shape which corresponds to a hollow section and on which the diaphragm rests. The diaphragm is thus formed in a
15 bowl-like manner, a central region being exposed in the upward direction. According to one version, it may be advantageous if the securing part does not engage around the diaphragm, in particular in the case of the integral connection. From the point of view of positive
20 locking, however, an advantageous solution is one according to which the securing part engages around the diaphragm. The periphery of the diaphragm can thus, for all practical purposes, be pushed into an annular groove. It proves to be advantageous here if that
25 cross-sectional length of the diaphragm which does not have the securing part engaging around it but coincides therewith is greater than the length around which the securing part engages. This results in a directing surface for the introduction of the periphery of the
30 diaphragm, this directing surface being advantageous for installation purposes and being disposed in front of the said groove. Furthermore, an advantageous positioning method appears to be one according to which the diaphragm is connected integrally to the securing
35 part by means of an adhesion promoter. Thermoplastic elastomers may be used here. Particularly cost-effective production is correspondingly achieved in that the diaphragm is connected to the securing part by two-component injection molding. In respect of the

diaphragm, it is possible to use material with fairly thin walls. In this case, excellent stability to curvature is provided if the radius of curvature of the diaphragm is between the dimension of the diameter and 5 that of the radius, preferably four fifths of the diameter. In the case of the present application, the diameter is approximately 19 mm. The thickness of the diaphragm, which preferably consists of silicone, is approximately 0.5 mm. This is based on a Shore hardness 10 of 60. The diaphragm is also produced separately from the securing part and, prior to connection to the securing part, configured with a planar surface. The dome shape which is forced from the original planar shape compresses the periphery of such a disk. This can 15 range as far as macroscopically but non-detectable peripheral undulation, with radial orientation of the top of the peaks, and of the bottom of the trough, of the undulation. This all results in characteristic internal stress. The compression-based thickening of 20 the periphery of the diaphragm aids, for example, the positively locking connection explained above, this being on account of expansion clamping.

The invention then relates to a closure which is 25 produced by plastic injection molding and is intended for a dispensing container, for example a preferably blow-molded bottle, the closure having a self-closing diaphragm valve which interacts with a securing part, and proposes, in order to achieve an advantageous 30 configuration, that the diaphragm, which is of dome-like configuration even in the free-span region, is connected in a positively locking or integral manner to the securing part, the securing part being secured in the closure by latching. It is advantageous in terms of 35 positioning here if the closure part, which encircles the securing part on the outside, acts on the diaphragm, at the same time, in the manner of a cutting edge in the region of overlap with the securing part. In order, furthermore, to avoid the situation where the

medium penetrates too forcefully in the case of the dispensing operation taking place with the container upside down, the diaphragm has a deflecting holder of the closure part, the deflecting holder having
5 apertures, positioned beneath it. The apertures act in the manner of an air lock. That part of the diaphragm which is located in the flow center is, as it were, screened in that a crosspiece of the deflecting holder is assigned to the opening slit of the diaphragm in
10 vertical projection. In order to achieve a supply directly on the dispensing side, the deflecting holder is positioned at a free distance beneath the diaphragm. The main supply or the rest of the supply of medium which is to be dispensed is, as it were, held back
15 behind the deflecting wall. The invention also relates to a closure in the case of which the diaphragm rests at least centrally on the plate part. It is provided here that the plate part is formed to taper in the direction of the diaphragm. Furthermore, this solution
20 is characterized in that the plate part tapers in a step-like manner. A precaution is taken here such that the diaphragm rests with prestressing on the plate part or vice versa.

25 An advantageous development of the closure, moreover, consists in that the closure has a closure lid, in that a cup which is open at the bottom is integrally formed on the closure lid in the region of overlap with the diaphragm, and in that the free end periphery of the
30 cup, in the closed state, is seated in a sealing manner on the diaphragm, and in that the plate part, which is attached via resilient arms, bears beneath the diaphragm. A further function is thus performed by the valve diaphragm; it forms a sealing seat surface which
35 interacts with the closing member, in this case the closure lid. Compressive forces acting on the dispensing container, heat-induced expansion of the material which is to be dispensed, fermenting processes, etc. do not give rise to passage beyond the

discharging region. Rather, the pressure component even has a sealing-enhancing action since the diaphragm is forced even more firmly against the end periphery of the cup. It is also the case, however, that the slit in
5 the diaphragm is kept closed on account of the plate part. Since the latter is attached to resilient arms, it is possible for it, within limits, to accompany the movement, with the effect of a pushing-out action. This pushing-out action, however, is effectively limited. It
10 takes place, as it were, counter to an "air cushion" enclosed in the cup. Provision may also be made during injection molding for the operation of integrally forming a cup, even an end periphery coordinated with the spherical configuration of the diaphragm. Even a
15 partial hernia-like compression of diaphragm material in the discharging region is effectively prevented, since the free outer periphery of the cup is directly adjacent to the inner wall of the diaphragm in the closed state. This can even go as far as achieving an
20 additional sealing location if, as is further proposed, the outer periphery of the cup bears in a sealing manner against the inner periphery of the securing part. This second sealing location is further enhanced in that the securing part, associated with the outer
25 periphery of the cup, has a sealing profiling. The latter may be rotationally symmetrical, bead-like ribbing. A number of ribs may be formed. It is then provided that the outer periphery of the cup has longitudinal ribs which are seated on the securing part
30 in the closed position of the closure. This aids the peripheral anchoring of the securing part and also has an advantageous effect in respect of the desired sealing of the retained diaphragm. Furthermore, in one possible configuration, slits of the diaphragm are
35 provided such that they project beyond the plate part in the radially outward direction. This is because just covering the slit center by the plate part, this giving the effect of a deflecting wall, is usually sufficient. Moreover, the slits themselves, since they run in a

zone of curvature and the compressive forces run from the vertex, are self-closing, that is until an envisaged pressure threshold, beneath which the diaphragm pushes out spontaneously, is exceeded, which
5 takes place when the material which is to be dispensed is deliberately discharged.

Finally, the invention proposes a closure in which the periphery of the closure lid has a latching button of
10 the closure passing through it, it being possible for this latching button to be used for tamperproof sealing, and the latching button having a surface which is structured in a rib-like manner. Vertical ribs are formed. The ribs replace a central latching-button hollow, the latter nevertheless having been mistaken by
15 the user, in the past, for a dispensing opening. Since the base of the blind-bore-like hollow is closed, there have been previous cases of piercing being used in order to open the supposed "dispensing nozzle". The
20 rib-like structure, in contrast, does not encourage the abovedescribed handling.

To conclude, the invention relates to a process for producing a self-closing diaphragm valve with a
25 diaphragm fitted in an annular securing part, the diaphragm consisting of an elastomer, in particular a silicone material. The developing feature steps here are characterized in that, in the first instance, the securing part is produced by plastic injection molding,
30 and in that the elastomer material is then added in a fluid state to the securing part accommodated in a mold and, with the aid of a counter-mold, the elastomer material is distributed in order to form the diaphragm as desired. The elastomer material may be added as a
35 sub-quantity, for example simply by being supplied in droplet form. This results in both a weld-like connection and a partially positively locking connection in relation to the securing part. This is utilized in order to achieve a new geometry, to be

precise with the effect of providing integrally formed curvature, which is correspondingly free of stressing.

The subject matters of the rest of the process claims
5 are explained hereinbelow in relation to the subject matter of Claim 24, but may also be important in respect of their independent wording. It is thus proposed that the elastomer material, which cures preferably by a crosslinking reaction, is connected in
10 an integral and/or positively locking manner to the securing part, rear-engagement regions being formed in respect of the positive locking. This results in a version of a diaphragm valve which is extremely stable in mechanical terms. The positively locking rear-
15 engagement regions form, as it were, a peripheral clamp. In a structurally straightforward manner, the procedure is then such that the elastomer material is prepared for application by means of an extruder, and that, in a following processing step, a slit is formed
20 in order to provide a dispensing opening. It is also the case that the slit, since it is produced in a state in which it is relieved of stressing, is not subjected to any deformation. This results in the diaphragm valve closing itself in a reliable manner.
25

The invention ultimately relates to a self-closing diaphragm valve which is accommodated in an annular securing part, produced by plastic injection molding, and has a diaphragm made of an elastomer material with
30 a slit for forming a dispensing opening when acted upon by pressure, and proposes that the diaphragm, when formed in a manner in which it is free of cut edges on its circumferential periphery, is connected in a positively locking and/or integral manner to the
35 securing part.

The subject matter of the invention is explained in more detail hereinbelow with reference to an exemplary embodiment illustrated in the drawing, in which:

- Fig. 1 shows the plan view of a material strip with diaphragms which have been punched for removal purposes and are provided on the periphery with an adhesion promoter,
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- Fig. 2 shows, on an enlarged scale, a separated-out diaphragm in cross-section,
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- Fig. 3 shows the diaphragm associated with a securing part,
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- Fig. 4 shows a closure part which can be fitted with the diaphragm valve, but has not yet been fitted therewith,
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- Fig. 5 shows the same closure part, this time provided with the self-closing diaphragm valve,
20 Fig. 6 shows a variant of the diaphragm in a sectional illustration like that of Fig. 2,
25 Fig. 7 shows the diaphragm completed with the securing part, in an illustration like that of Fig. 3, using a positively locking connection between the two basic elements,
30 Fig. 8 shows, once again, a section through the closure part fitted with this diaphragm valve,
35 Fig. 9 shows a cross-section through the securing part in a plug-in-channel profile which has been modified in relation to Fig. 8,
35 Fig. 10 shows an illustration like that of Fig. 9, showing a plug-in-channel profile which has, once again, been modified,

- Fig. 11 shows a closure which has been fitted with the diaphragm and has a plate part bearing against the diaphragm, to be precise in a bottom view with the closure swung open,
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- Fig. 12 shows the section along line XII-XII in Fig. 11,
- Fig. 13 shows an enlargement XIII from Fig. 12,
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- Fig. 14 shows the closure in an illustration like that of Fig. 12, but latched in the closed position,
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- Fig. 15 shows an illustration like that of Fig. 14, but with a tamperproof seal being broken,
Fig. 16 shows an enlargement XVI from Fig. 14,
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- Fig. 17 shows a perspective view, to be precise of the hollowed side, of the diaphragm accommodated in a securing part,
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- Fig. 18 shows the same, but with a view of the rear side,
Fig. 19 shows an enlargement of that region of the closure which has the tamperproof seal,
30
- Fig. 20 shows a section, corresponding to Fig. 16, with the diaphragm curved outward into the discharging position,
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- Fig. 21 shows a cross-section through the securing part with the hollow oriented downward,
Fig. 22 shows the securing part, which has been prefabricated, accommodated in a mold, provided

with a sub-quantity of elastomer material in droplet form and in the fluid state,

5 Fig. 23 shows an illustration corresponding to Fig. 22, but with the counter-mold placed in a mold-closing position,

10 Fig. 24 shows a plan view of the diaphragm valve following production of a slit in order to provide the dispensing opening,

Fig. 25 shows the section along line XXV-XXV in Fig. 24,

15 Fig. 26 shows a closure which has been fitted with the diaphragm and has a modified plate part bearing against the diaphragm, to be precise in plan view with the closure swung open,

20 Fig. 27 shows an illustration like that of Figure 26, but with the diaphragm valve not yet placed in position,

25 Fig. 28 shows, on an enlarged scale, the section along line XXVIII-XXVIII in Figure 26, and

Fig. 29 shows a modified configuration of the plate part, shown as a magnified illustration.

30 The diaphragm valve, which is designated as a whole by V, comprises a diaphragm or diaphragms 1 and a securing part 2 which carries the same.

35 The circular, disk-like diaphragm 1 is punched out of a band-like, planar material strip 3. Use is made of plastic sheet material, preferably silicone. The thickness is approximately 5 mm and the Shore hardness is around 60.

The punched patches, which are positioned in a space-saving manner, are correspondingly closely adjacent to one another. A diametrically running slit 4, which forms a lip-like mouth, is also punched at the same
5 time. The slit 4 extends in a central area of the diaphragm 1 and, in contrast to the illustration, may also be realized as a cross-slit, so that, in this case, there are four valve segments, forming a star-shaped opening.

10

Small attachment crosspieces 5 may be provided for in the periphery of the diaphragm 1, so that the punched patches are kept together with the surrounding punching waste, this resulting in them being kept in stock in
15 the form of a reel or roll, or else in the form of a stack, of a zigzag arrangement, etc.

The originally planar diaphragm 1 is associated with the securing part 2 in the form of a spherical cap.
20 Transferring to the correspondingly dome-like configuration results in characteristic internal stress in the corresponding mounting region 6 of the diaphragm 1, this internal stress continuing, as it were, in a stabilizing manner in a stabilizing manner into the
25 non-connected central area of the diaphragm 1, which is curved in a rotationally symmetrical manner. The corresponding curvature is counter to the discharging direction indicated by arrow x (see, for example, Figure 5).

30

The diaphragm valve V may be positioned on a closure part 7.

The closure part 7 is realized on a closure 8. This is
35 located in the head region of a dispensing container 9, for example a blow-molded bottle with at least partially collapsible wall sections, this providing the function of a squeeze bottle which can be compressed in order for the contents of the dispensing container 9,

for example a liquid to pasty medium, to be discharged in a specific manner via the closure 8, with control provided by the self-closing diaphragm valve V. As the internal pressure decreases, the said valve V moves
5 back into the closed position again on account of the inherent restoring force of the diaphragm 1. Air equalization takes place by the opening of the slit 4 opening up in a lip-like manner counter to the direction of arrow x on account of negative pressure.

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The annular securing part 2 is connected in a positively locking or integral manner to the diaphragm 1.

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It is thus possible for the frame-like element, which encircles the central area of the diaphragm 1, to be provided by encapsulation by injection molding.

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If use is made of a diaphragm 1 made of silicone, an adhesion promoter 10 is used. You are referred to Figures 1 and 2. The adhesion promoter 10 is shown by patterns of dots there, and is illustrated in Figure 2 as a layer.

Adhesives may be used in other cases.

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In the case of such diaphragm valves V, which are also produced by two-component injection molding, it is ensured that the diaphragm 1, in the mounting region 6, fits snugly into the silhouette on the underside of the
30 securing part 2. As can be gathered, the outer side of the dome-like diaphragm 1 continues flush into the corresponding outer side of the securing part 2. The narrowed periphery of the diaphragm 1 thus engages against a step 11 and/or terminates thereon.

35

In outwardly directed extension, the securing part 2 is formed in order to be secured in the closure part 7 by latching or over-engagement on the outer periphery of the circumference.

The corresponding anchoring action is achieved by a latching nose 13 which is integrally formed on the outer periphery 12 of the securing part 2. This latching nose engages beneath a horizontal latching 5 shoulder 14 of the closure part 7. As can be gathered, the latching nose 13 projects into an open groove 15, which is directed inwards toward the diaphragm 1.

Beneath the latching shoulder 14, the groove 15 10 continues into a correspondingly inwardly directed, horizontal flank 16. The flank 16 is developed with the effect of providing anchoring support and, in addition, also performs a sealing action. This is embodied in that the closure part 7, which encloses the securing 15 part 2 in a tire-like manner on the outside, acts on the diaphragm 1, at the same time, in the manner of a cutting edge in the region of overlap with the securing part 2. This is evident from Figure 5. The cutting edge is designated 17. It penetrates into the elastic layer- 20 like body of the diaphragm 1. Of course, the cutting edge 17, which is rotationally symmetrical all the way round, is not profiled for cutting. It assists the integral connection of the diaphragm 1 at the foot of the diaphragm dome.

25 The variant according to Figure 8 is of identical configuration in respect of the actual latching means. The designations have been used analogously if necessary for comprehension, in some cases without 30 being repeated in the text. In this case, however, as a development, the nose 13 continues into a vertically oriented annular crosspiece 18 of the securing part 2. This is seated, axially, as seen in the container direction, in a stop-defined manner on the flank 16, 35 and anchored in the opposite direction by the clip means 13/14.

The annular crosspiece 16, which provides material accumulation in the region of the step 11, is utilized

in order to achieve the positively locking connection between the diaphragm 1 and the securing part 2.

If, according to the basic version, the diaphragm 1
5 does not have the securing part 2 engaging all the way around it there, the variant of Figure 8, in contrast, provides for the securing part 2 to engage around the periphery of the diaphragm 1 on both broad sides of the latter. The engagement section provided by the material 10 of the annular crosspiece 16, however, is short, which, as has been found, is also sufficient on account of the internal stress explained above. The operation of placing the periphery of the diaphragm 1 in position, for all practical purposes plugging it in, may be 15 achieved via an annular push rod. That cross-sectional length of the diaphragm 1 which does not have the securing part 2 engaging around it here but coincides therewith is thus greater than the length around which the securing part engages on the underside. The plug-in 20 channel which accommodates the free end is designated 19. The dome-like mounting region 6 of this securing part 2, in the direction of the upper flank of the plug-in channel 19, provides a relatively long guide surface for carrying out the installation.

25 In both cases, the upper section of the securing part 2, which is directed toward the concave side of the diaphragm 1 and forms the mounting region 6, is obviously formed as a flat part with an inwardly 30 directed, tapering lip arrangement 20. This terminates at a fair distance before the end of the slit or slits 4. This means that there is also still sufficient room for movement for the free-span curved region of the diaphragm 1, for the purpose of curving outwards in the 35 discharging direction indicated by arrow x, this taking place via the dead-center line defined by 20. The return curvature is brought about by the restoring force of the diaphragm 1.

The annular flat part or securing part 2 converges in the direction of the center of the diaphragm 1. It is thus possible for residual quantities of medium which have not been discharged, that is to say they have not
5 freed from the lip mouth, and are collected in front of the slit 4, to be sucked back into the dispensing container 9 again, via the slit 4, by negative pressure. The correspondingly plate-like hollow, which forms something of a collecting basin, is designated
10 21.

In respect of the geometry of the diaphragm 1, it should also be noted that the radius of curvature R of the diaphragm 1 both of the basic version and that of
15 the variant is between the dimension of the diameter D and that of the radius of the diaphragm 1, preferably four fifths of the diameter D. The diameter D is 19 mm. The free-span region takes up about half the diameter D. The thickness of the diaphragm valve V throughout is
20 approximately a quarter of the diameter D.

Even in the case of geometries which tend toward a shorter radius value, the diaphragm 1, prior to connection to the securing part 2, has a planar
25 surface.

The closure 8 is produced by plastic injection molding. It is also possible here to provide for further functional elements, for example a closure lid 22. This
30 is positioned above the discharging region 23 such that it can be moved out of the dispensing path. In its basic position, that is to say in its protective position, the closure lid 22, which is realized as a swing lid, disappears into a head-side transverse shaft
35 24 in the top 25 of the closure 8.

Likewise extending from the top 25, counter to the discharging direction indicated by arrow x, are

attachment means 26 for connecting the closure 8 with anchoring means on the neck of the dispensing container 9.

Furthermore, the closure 8 provides for a deflecting holder 27 of the closure part 7, this deflecting holder being disposed in front of the convex side of the dome-like diaphragm 1. The flow-restraining part of the deflecting holder 27 is positioned at a free vertical distance y beneath the diaphragm 1. The region of the slit 4 here is specifically protected. As can be gathered, a crosspiece 28 is associated with the slit 4 of the diaphragm 1 in vertical projection. The crosspiece 28 may be a wall-like base section of the holder 27. The through-passages for the medium which is to be discharged are only located on the periphery of this crosspiece 28, which forms a shield or a deflecting wall. The apertures in this respect are designated 29. They release the path to an antechamber 30 of the closure 8, this antechamber being based on the free distance y .

The variants of plug-in-channel profiles which are illustrated in Figs 9 and 10 constitute a development of the positively locking solution which has been described in relation to Fig. 8. The designations are used analogously, in some cases without being repeated in the text. The under-engaging part of the plug-in channel 19 thus starts at the outwardly directed end of the mounting region 6. The base of the plug-in channel follows the slightly conical or frustoconical peripheral profile of the diaphragm 1. The corresponding slight tapering results from the curvature of the diaphragm 1. The flank 31 of the plug-in channel 19, this flank being directed toward the underside of the diaphragm 1, projects from said underside and leaves an annular gap 32. The outlet of the gap is rounded convexly on the flank 31 and merges into the annular crosspiece 18 on the outside via an oppositely directed slope. The transition to the base

of the plug-in channel 19 is also rounded, to be precise, concavely.

This configuration aids the plug-in positioning. It is
5 also possible, however, to provide such an annular gap
32 for integral connection utilizing the mounting region
6.

The variant of Figure 10 is realized as has been
10 described above apart from a single detail, the base of
the plug-in channel 19 running strictly in the
direction of the radius R. The conical periphery of the
diaphragm 1 thus rises up from the base of the plug-in
channel 19 in a wedge-shaped manner in accordance with
15 the said frustoconical profile and only starts at an
annular rib 33 on or above the base of the annular gap
33 disposed in front.

The securing part 2, which in this case is more or less
20 V-shaped in cross-section, expediently has the gate
mark in the vertex of the V, that is to say on the
upper edge of the outer periphery 12.

The radius R is only produced by the integrally molded
25 securing-part ring. In this case, the inner side of the
concave body forms the compression fiber and the
convex, outer side forms the fiber under tension, this
resulting in the narrow periphery of the diaphragm 1
being oriented in a frustoconical manner.

30 The closure 8 according to the development in Figures
11 to 20 is basically of the same construction. The
designations have been used analogously if necessary
for understanding, in some cases without being repeated
35 in the text. It is thus also the case here that a
cutting edge 17 extends from the flank 16, the cutting
edge encircling the discharging region 23 of the
closure 8 in the form of an annular sealing bead. The
cutting-edge-like crest of this annular sealing bead,

however, in this case is positioned more in the central region of the abutment-forming mounting region 6.

There is then a change in respect of the deflecting
5 holder 27 which has been described. It is replaced by a plate part 34. This extends beneath the diaphragm 1, that is to say it is directed toward the product 35 which is to be dispensed. It is thus not possible for the liquid product 35, which comes up against the head
10 of the closure 8 of the dispenser, for example, if the dispensing container 9 is positioned upside down, to escape. Proper dispensing of a quantity of product 35 is normally only possible by the wall of the dispensing container 9 being squeezed deliberately (see Fig. 20).

15

The plate part 34, for all practical purposes, bears against the outer wall 36 of the diaphragm 1. It is thus configured with concave curvature matching the convex profile of the diaphragm valve V. If need be,
20 there is a small gap between the two curved parts.

The plate part 34 is of the same thickness throughout. Consequently, the surface which is directed away from the diaphragm 1 thus also has matching convex
25 curvature. This produces a laterally deflecting flow component when the product 35 strikes against it. The corresponding flow-distributing function in the radially outward direction all the way round can also be enhanced further by providing, for example, the
30 abovementioned parts with a more intense curved profile.

The plate part 34, furthermore, is attached to the closure part 7 via resilient arms 37. The resilient
35 arms 37 function as pressure-absorbing springs. A total of three resilient arms 37, each distributed at equal angles, are realized in the region of an annular through-passage 38. You are referred to Fig. 11.

As can be gathered, the resilient arms 37 are of Z-shaped configuration. A Z-crosspiece 39 follows the central region of the annular through-passage 38, to be precise concentrically. Radially oriented attachment crosspieces 40 start in the end regions of the Z-crosspiece 39. The attachment crosspieces form, as it were, the Z-legs. An inwardly directed attachment crosspiece 40 is rooted in the periphery of the plate part 34; an outwardly oriented attachment crosspiece 40 of the same 5 resilient arm 37 starts at that periphery of a sunken base 41 of the top 25 of the closure part 7 which bounds the through-passage 38 in the outward direction. An integral connection to the closure 8 and, if appropriate, also to the dispensing container 9 is 10 formed here. For further details, you are referred to German patent application 102 18 363. The disclosure contents of this application are included in full, also for the purpose of incorporating features of these 15 documents in claims of the present application.

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With the closure lid 22 closed, the diaphragm 1, which is curved in the direction of the product 35, is supported in the latched, closed position by this lid. This takes place, in accordance with the abovementioned 25 forerunner, using a holding-down means which is integrally formed on the closure lid 22 in accordance with the profile of the slits 4. In the case of an individual slit, the holding-down means is in the form of a crosspiece; in the case of a cross-slit, it is a matching cross-shaped spike. In the closed state, the 30 holding-down means thus interacts with the diaphragm in a position-securing manner. Good transporting protection is thus provided. The entire arrangement is also supported from the inside by the plate 35 part/resilient arms 34/37 unit, which functions as a pressure-absorbing spring.

The abovedescribed holding-down means is used, in a development of the closure 8, for product-protecting

sealing purposes. For this purpose, the closure lid 22 of the closure 8 has a cup 42. This extends from the inner side of the closure lid 22, which is realized, as has been said, as a swing lid, and opens downwards,
5 i.e. in the direction of the diaphragm 1.

The cup 42, which is integrally formed in the region of overlap with the diaphragm 1 and, for all practical purposes, is cylindrical, engages in a sealing manner,
10 by way of its free end periphery 43, in the closed state of the closure 8 against the corresponding inner wall 44 of the hollow 21 of the diaphragm 1. The plate part 34/resilient arms 37 unit provides an effective resilient abutment. It is possible for the material of
15 the diaphragm 1 to yield elastically, within limits, in this respect, in which case, conversely, positive pressure produced in the interior of the dispensing container 9 further enhances the sealing closure and/or the sealing seating of the cup 42 as it approaches in
20 the inverted state.

As can be gathered from Fig. 16, the end periphery 43 is configured to follow the contour of the diaphragm 1, more precisely the inner wall 44, that is to say such
25 that it slopes down in the outward direction in a slightly frustoconical manner here.

As far as the congruent seating of the cup 42 in respect of the aperture 45 of the diaphragm 1, the
30 aperture being encircled by the lip arrangement 20, is concerned, this also has centering action in relation to the securing part 2.

However, this also makes it possible at the same time
35 to achieve a second sealing action between the parts 2 and 42, which is embodied in that the free outer periphery 46 of the cup 42 is directly adjacent to the inner wall 44 of the diaphragm 1 in the closed state, in which case, in addition to the correct orientation

being achieved, the situation where the outer periphery 46 of the cup 42 bears in a sealing manner against the inner periphery 47 of the aperture 45 of the securing part 2 is also achieved. The material has a 5 correspondingly elastomeric character.

To increase the sealing action, the securing part 2, associated with the outer periphery 46 of the cup 42, has a sealing profiling 48. This achieves threefold 10 sealing via the diaphragm valve V, namely via the cutting edge 17, which presses into the diaphragm 1, via the end periphery 43, which positions itself in a sealing manner on the diaphragm 1 in the opposite direction, and via the centering location between the 15 outer wall 46 of the cup 42, this interacting in a sealing manner with the inner wall 47 of the securing part 2, which forms part of the diaphragm valve V.

The expansion action which has been mentioned, however 20 caused, results in the diaphragm 1 pushing out on the cup side, to be precise counter to the resistance of the air enclosed in the cup 42. The corresponding "air cushion" acts in a compliant, but nevertheless an increasingly expansion-inhibiting, manner. There are no 25 losses of product 35 from leakage, even when the slit 4 of the diaphragm 1 is provided such that it projects beyond the plate part 34 in the radially outward direction. Rather, in the expansion stage described, pressure acting on the outer wall 36 of the diaphragm 1 30 has a slit-closing tendency, this slit 4 only opening when actuating pressure which is necessary for operation is applied.

The closure lid 22 is retained in the closed position 35 on the closure part 7 by common latching means. The attachment takes place via a peripheral film hinge 50. The closure 8 can be connected to the neck of the dispensing container 9, to provide sealing closure, via threaded engagement.

The periphery of the closure lid 22 has a latching button 51 of the closure 8 passing through it. The latching button 51 is used, at the same time, for tamperproof sealing. In respect of such measures, you
5 are referred, once again, to the abovementioned German patent application. In one development, said latching button 51, then, is of rib-like formation on the visible side. The ribs of such a surface are designated 52. They improve the grip and prevent the initially
10 described manipulations in respect of supposedly creating a dispensing path.

The latching button 51 is mounted in the manner of a tilting lever at the top of the closure part 7 via a
15 tongue. This articulation location is designated 54. The latching button 51 is retained at the bottom of the closure part 7 via a predetermined breaking point 55. The latching button 51 projects, for actuating access, through the eye of a loop 56 of the closure lid 22.
20 Once moved out of the latched position, the tamperproof seal 53 is broken. The latching button 51 is then usually anchored such that it cannot be pulled out. First-time use of the container is thus obvious.

25 The securing part 2 illustrated in the drawing from Fig. 21 onward corresponds, in terms of shape and construction, to that according to Figs. 3 and 7, regardless of whether a rear-engagement region 57 is desired or not. The latter runs arcuately parallel to
30 the mounting region 6 and forms, as a plug-in channel 19, the contour of the circumferential periphery 58 of the diaphragm 1 which is to be formed.

35 The rear-engagement region 57, as a rotationally symmetrical flank of the plug-in channel 19, is considerably shorter than the arcuately parallel mounting region 6.

According to the specification for Fig. 21 onward, the diaphragm 1 is integrally formed utilizing the plug-in channel 19, in this case involved in the molding operation.

5

The diaphragm 1 consists of an elastomer, in particular a silicone material, referred to throughout as elastomer material 59.

10 The securing part 2, which is produced by plastic injection molding, is accommodated in a mold 60. This has a mold cavity 61 with a contour corresponding to the associated side of the securing part 2. As can be gathered, the mold cavity allows for the profile of the
15 flank 16 of the annular crosspiece 18 and also for the profile of the latching nose 13 in the region of the outer periphery 12 of the securing part 2.

Following the mold cavity 61, the central region of the
20 mold 60 follows, in terms of cross-section, an arcuate line 62. The radius of curvature corresponds substantially to that which has been explained above, although in this case it is designated R'. R extends through the central fiber of the diaphragm, while R' is
25 identical to the inner fiber.

The arcuate line 62 and the mounting regions 6, which slope down to the periphery, are completely flush on the upper side.

30

The elastomer material 59 is then fed, to be precise in the fluid state, to the securing part 2 accommodated in the mold 60. This suitably takes place at the vertex of the spherical region of the mold 60. The corresponding
35 addition is illustrated as a material accumulation in droplet form.

The mold 60 set up in this way is then provided with a counter-mold 63, which completes the mold cavity 61.

This counter-mold, upon closure, distributes the elastomer material 59 in order to form the diaphragm as desired. The closed mold arrangement, which is comparable to the waffle-iron principle, can be 5 gathered from Fig. 23. It operates without injection points.

Any air enclosed passes out of the mold arrangement in the region of the plug-in channel 19, which is finally 10 completely filled, the air passing out, for example, via axial transverse channels 64 which are incorporated in the annular crosspiece 18 and adjoin vent holes 65 of the mold 60, which are open at the bottom.

15 The congruent arrangement of the air-discharging elements may be ensured by following relevant markings (not illustrated).

The elastomer material 59, which cures preferably by a 20 crosslinking reaction, is connected at least integrally to the contact surfaces of the securing part. This would correspond to an attachment contour as can be gathered from Fig. 3. If, in contrast, a positively locking securing action is desired at the same time, 25 then this is brought about via the abovedescribed rear-engagement regions 57, which provide for an engagement over three adjacent sides.

30 The mating spherical arcuate line of the internally concave counter-mold 63 is designated 66. You are referred to Fig. 23.

The elastomer material 59 is supplied and apportioned 35 by means of an extruder (not illustrated). The quantity used up can be precisely established, so that excess discharge is avoided. Any additional quantities, moreover, can also move out into the transverse channels 64. They perform a stopper function there, it also being the case that passage beyond the sheet

material forming the diaphragm 1, in combination with the crosslinking achieved, is intrinsically ruled out for all practical purposes.

5 Added to this is the fact that the circumferential periphery 58 of the diaphragm 1, in contrast to a punched-out diaphragm 1, is formed without any cut edges. Rather, the circumferential periphery 58 is formed in a close-fitting manner, that is to say it
10 adapts very well to tolerance deviations. It is generally the case that depositing a droplet-like quantity of elastomer material 59 at the center of the highest point of the concavely curved mold 60 is excellent for providing good distribution. The same
15 distributing conditions are present in the radially outward direction. These are further enhanced by the profile of the contour determined by the arcuate line 62, this profile sloping downward in a rotationally symmetrical manner.

20 Overall, the invention provides a self-closing diaphragm valve V which is accommodated in an annular securing part 2, produced plastic injection molding, and has a diaphragm 1 made of an elastomer material 59
25 with a slit 4 for forming a dispensing opening, the latter responding when the collapsible wall of the dispensing container 9 is acted upon by pressure, and, when formed in a manner in which it is free of cut edges on its circumferential periphery 58, the
30 diaphragm 1 is connected in a positively locking and/or integral manner to the securing part 2.

The variant of Figure 26 onwards corresponds, in terms of basic construction, to the basic version which has
35 been illustrated in detail, in particular to the configuration according to Figure 16. The designations are used analogously, in some cases without being repeated in the text.

A structural modification in relation to Figure 16, then, consists in the diaphragm 1 resting at least centrally on the plate part 34 positioned beneath it. This results in central support with slight indentation
5 in the core of the cross-slit region. The slit 4 may also be configured differently.

It is the outer wall 36 of the diaphragm 1 which is involved here. The plate part 34 tapers centrally to a
10 stub 67 in the form of a flat disk. The upper surface of this stub is of planar configuration. In the case of a dispenser version with a closure 8 of the magnitude which can be gathered from Figure 26, the surface of the stub measures approximately 1 to 2 mm.

15 The tapering may be of trumpet-like configuration, as can be gathered from Figure 29, that is to say a protuberance extending in the direction of the dispensing container 9, or else in the manner of a
20 stepped cone 68 (see Figure 28).

The latter has a base corresponding to a number of times the diameter of the cylindrical stub 67. Said base, which is itself configured in the form of a disk,
25 is rooted in the upper side of the plate part 34, the latter likewise being in the form of a disk, from which the resilient arms 37 extend in the manner described.

30 The steps, which are all provided in an interspace between the diaphragm 1 and the plate part 34, are designated 69. They run concentrically in relation to one another. The periphery of the plate part 34, at the same time, forms a step 69.

35 The region outside the center, which is located around the central support, is an enlarged annular gap 70. The latter aids the discharge, for example, of pellet-like bodies, in particular guidance toward the pushing-out slit region of the diaphragm 1.

The stubs 69, which are located in the manner of chicanes in the flow region, help to loosen the substance which is to be discharged.

- 5 The plate part 34, which subjects the diaphragm 1 to a gap-enlarging forcing action and has a protrusion in the center, may be subjected to prestressing in the dispensing direction. This can be achieved extremely well during the injection-molding operation via the
10 connecting bridges, in the form of resilient arms 37, in the direction of the base 41. In addition, or instead of this, it is also possible for the diaphragm 1 to have support-enhancing prestressing.
- 15 When the material which is to be dispensed is discharged, the diaphragm 1 pushes outwards in the manner which is shown in Figure 20, in which case, at the same time, the annular gap 70 visibly widens beyond the antechamber size achieved. The through-passage of
20 the closure 8 is also designated 38 here. It is made up of all the free surroundings of the resilient arms 37.

It is nevertheless also possible here for the dispensing substance to be in liquid form.

- 25 It is then also one development in respect of the cup 42. This structural modification provides that the outer periphery 46 of the cup 42 has longitudinal ribs 71 which are seated on the securing part 2 in the
30 closed position of the closure 8. These longitudinal ribs extend virtually over the entire height of the lateral wall of the cylindrical cup 42. The radially outwardly projecting longitudinal ribs 71 are rooted both in the said lateral wall and in the top of the
35 swing lid 23 of the closure 8.

The distribution of the longitudinal ribs 71 can be seen from a glance, for example, at Figure 26. Two extend along the diameter of the cup 42, to be precise

parallel to the film hinge 50, which forms a swing axis. A third longitudinal rib is located at the angle bisector, to be precise on that side of the cup 42 which is directed away from the film hinge 50. Figure 5 28 uses chain-dotted lines to show a solution in which use is also made of a diametrical arrangement.

The end surface 72 of the longitudinal ribs 71, this end surface being directed towards the securing part 2, 10 is cut in a sloping manner to follow the indented profile of the lip arrangement 20 of the securing part 2. The end surfaces 72 converge in the direction of the diaphragm 1. The sloping profile is located approximately at an angle of 30° to 40° in relation to 15 a horizontal.

The end surfaces 72 still just extend in projection of the cutting edge 17. The downwardly forcing action of the longitudinal ribs 71, with utilization of the 20 elastic material of the diaphragm 1, results in an excellent sealing closure.

According to the basic version, the cup 42 itself performs the said holding-down function by way of its 25 end periphery 43. In the variant according to Figure 28, the corresponding end periphery 73 is provided by an inner chamfer. This can go as far as rotationally symmetrical, wedge-like tapering, which provides the periphery of the cup 42, in the region of the outer 30 periphery 46, with adaptive elasticity in relation to the inner periphery 47 of the lip arrangement 20. The positive pressure which occurs in the cup interior results in the reduced-material periphery of the cup 42 fitting closely in a sealing manner, which enhances the 35 desired sealing closure in relation to the inner periphery 47...

In the region of the film hinge 50, the closure 8 in question has a latching protrusion 74. The latter

interacts with a corresponding mating catch 75 of the swing lid 22. This devices takes effect when the swing lid 22 has been pivoted to a sufficient extent into its open position. It thus cannot cross the path of the
5 product which is to be dispensed; it is also the case that the view of the target location is not impaired.

The latching protrusion 74 and mating catch 75 are located in the region of a window-like cutout 76 of the
10 film hinge 50.

In front of the cutout 76 on the lid side, the lid 22 has a strip 77. This forms a screen. Since the strip is free-standing, liquid which is still located in the
15 dispensing region can run out/dry via the window-like cutout.

All features disclosed are (in themselves) pertinent to the invention. The disclosure contents of the
20 associated/attached priority documents (copy of the prior application) are hereby also included in full in the disclosure of the application, also for the purpose of incorporating features of these documents in claims of the present application.